United States
Department of
Agriculture

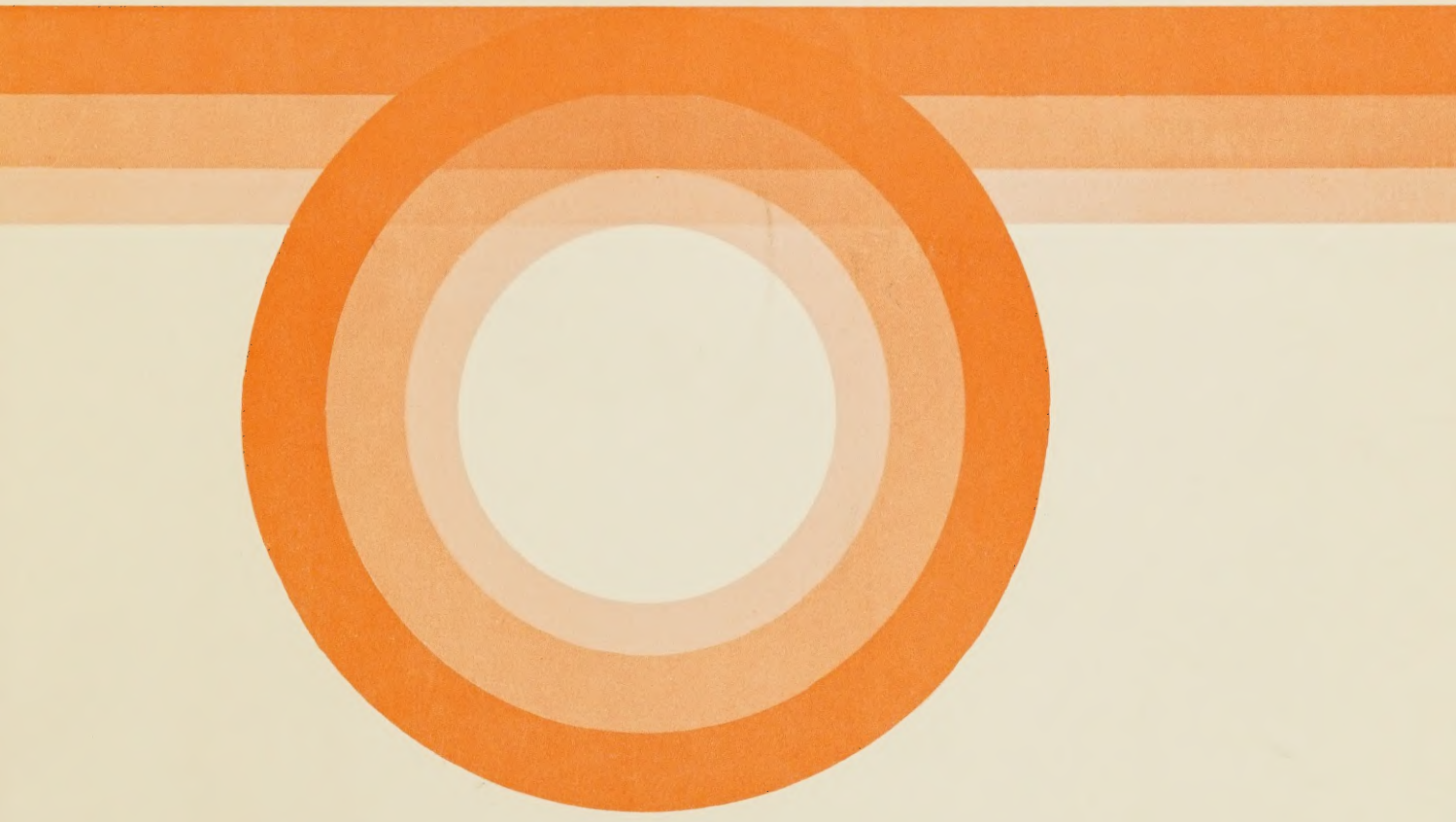
Forest Service

**Forest
Products
Laboratory**

1980/2

Dividends From Wood Research

Recent Publications



CONTENTS

Dividends From Wood Research

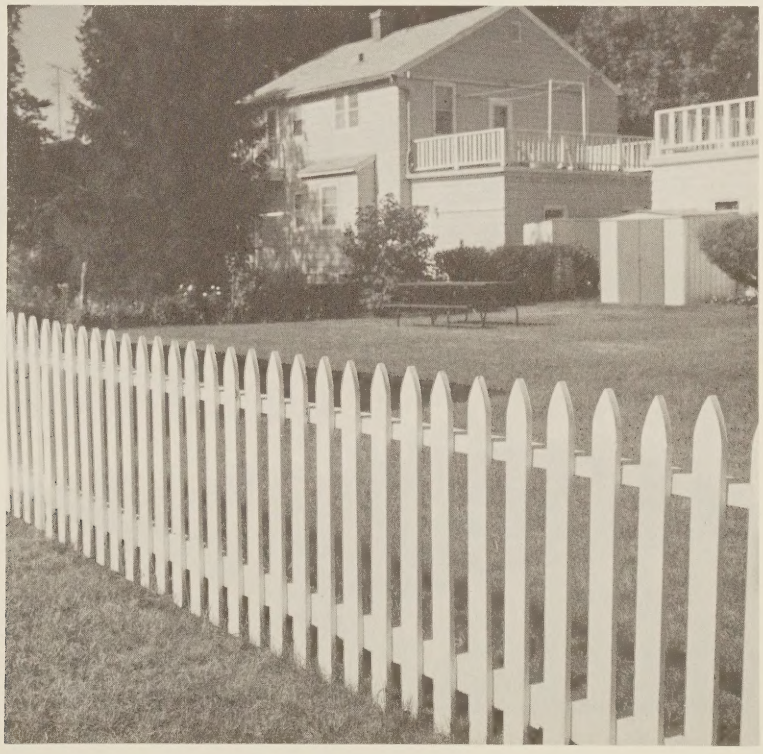
Dividends From Wood Research is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory. These publications are made available to the public to encourage private and commercial application of Forest Service research. The Forest Products Laboratory is maintained in Madison, Wisconsin, by the Forest Service, U.S. Department of Agriculture, in cooperation with the University of Wisconsin.

Research Highlights

Protecting Wood Fences for Yard and Garden

De Groot, Rodney C., William C. Feist, Wallace E. Eslyn, and Lee R. Gjovik
Available from University of Wisconsin-Extension/Madison, Agricultural Bulletin Building, 1535 Observatory Drive, Madison, Wisconsin 53706. Stock No. A3052, 15¢, 5p., 1979

If a fence is built with proper wood materials, protected against decay and termites, and regularly maintained, that fence will generally last. The authors discuss how, when and where to protect fences with pressure preservative treatments and water-repellent preservatives; how to select naturally durable woods and posts with mostly heartwood; how to maintain a fence with stain, painting, and repainting. A short list of useful fence-building tips is also given.



1 Full-Scale Testing of Wood Structures

Tuomi, R. L.
Special Tech. Pub. 702. American Society for Testing and Materials. 1980

Testing full-scale structures is important in understanding how completed structures perform in use. This information is essential to optimize structural performance, particularly the application of reliability-based design techniques. Unfortunately,there is little published information to serve as a guide to the engineering profession.

Many test procedures are equally applicable to complete structures regardless of the construction material. However, wood possesses many unique properties that must be considered. This paper highlights some of these unique properties of wood as they relate to structural evaluation, discusses some reasons for testing full-scale wood structures, and reviews some experiences in full-scale tests of timber members, components, and structures.

2 **Time, Costs, and Energy Consumption for Drying Red Oak Lumber as Affected by Thickness and Thickness Variation**

Simpson, William and John L. Tschernitz
For. Prod. J. 30(1):23-28. 1980

The time required to kiln-dry lumber is influenced by its thickness. Thicker material dries more slowly, increasing energy consumption and drying costs. This study analyzed the effect of thickness variation on drying time, costs, and energy consumption in kiln-drying 4/4 to 8/4 (1 to 2 inch) red oak lumber. Empirical drying rate data of red oak were generalized into an analytical function to allow estimates of drying rate to be calculated at any combination of the three variables. Potential benefits from controlling thickness variation in sawing could offer significant savings in kiln-drying costs.

3 **Design, Fabrication, Testing, and Installation of a Press-Lam Bridge**

Youngquist, J. A., D. S. Gromala, R. W. Jokerst, R. C. Moody, and J. L. Tschernitz
USDA For. Serv. Res. Pap. FPL 332. 1979.

Parallel Laminated Veneer (PLV) products are being examined as alternatives to solid-sawn timber or glulam for structural applications. Press-Lam, a PLV product developed at the U.S. Forest Products Laboratory, has exhibited decreases in variability of mechanical properties and increases in chemical preservative penetration and retention when compared to solid-sawn lumber. To examine the performance of a full-size Press-Lam structure in use, a prototype highway bridge of Press-Lam has been erected by the Virginia Department of Highways and Transportation. This report covers the materials, laminating, manufacture of components, design and component testing, as well as installation and evaluation of the bridge.

4 **Economic Models for Structural Flakeboard Production**

Harpole, George B.
Forest Prod. J. 29(12):26-28
1979

The computer programs Particleboard Variable Cost Program (PARVCOST) and Cash Flow Analysis (CFA) presented here answer a need for economic models that may be used to analyze and assess processes to manufacture structural flakeboard. The purpose of this paper is to: (1) announce the availability of the PARVCOST and CFA computer programs; (2) discuss the applicability of these programs to economic and managerial problems; and (3) outline the input and the output characteristics of each program. PARVCOST is essentially a mathematical model of wood, chemical, and energy flows within an operating flakeboard plant. The CFA program is a general-purpose discounted cash flow computer program designed to simulate and analyze investments, costs, and revenue cash flows of manufacturing ventures for up to 20 years. These programs are written in FORTRAN for use on Univac 1108 and 1110 systems and may be obtained from the author.

5 **Influence of Fine Grinding on the Hydrolysis of Cellulosic Materials — Acid vs. Enzymatic**

Millett, Merrill A., Marilyn J. Effland, and Daniel F. Caulfield
Hydrolysis of Cellulose: Mechanisms of Enzymatic and Acid Catalysis. 1979 American Chemical Society, Washington, DC

Lignin and cellulose crystallinity are major deterrents to the conversion of lignocellulose residues to useful products. For full use of carbohydrates in the millions of tons of currently used lignocelluloses generated in this country each year, some form of pretreatment must alter the fine structure of cellulose and open up the lignin-carbohydrate complex. Fine grinding with a vibratory ball appears to have a most direct effect on carbohydrate accessibility, reducing particle size to micron dimensions (expanding external surface area), and essentially eliminating crystallinity. This investigation was undertaken to evaluate the influence of fine grinding on the kinetics of the saccharification process—based on the responses from four cellulosic materials—cotton, linters, newsprint, Douglas-fir, and red oak.

6 **Hardboard and Insulation Board Plants in the United States—Capacity, Production, and Raw Material Requirements 1955-1978**

McKeever, David B.
USDA For. Serv. Res. Bull. FPL 7. 1979

Hardboard and structural insulating board are the generic terms applied to the two types of fibrous-felted boards currently classified by the American Society for Testing and Materials. This report provides estimates of hardboard and insulation board plant capacities for 1978 as well as industry capacity and production for the years 1955, 1960, 1965, 1970, 1976, and 1978. Imports and exports of hardboard and insulation board, as well as raw material requirements, are also discussed.

Anatomy & Properties

7 Wood Anatomy of the Neotropical Sapotaceae

Kukachka, B.F.
USDA For. Serv. Res. Pap. FPL 349 to 354. 1979

The tree family known as Sapotaceae represents a large volume of standing timber in the New World, especially in such areas as the Amazon Basin. However, the homogeneous nature of this family's floral characteristics makes generic identification extremely difficult. Better information would help in utilizing the timber of the Sapotaceae, especially if clearer identification of species results.

On the basis of their anatomy, Dr. Kukachka suggested numerous divisions. The first seven were published in 1978 and these six represent the next grouping. Each is contained in a separate research paper under the main heading of "Wood Anatomy of the Neotropical Sapotaceae" and a specific numbered subhead:

7-VIII. Diploon
7-IX. Pseudoxythece
7-X. Micropholis
7-XI. Prieurella
7-XII. Neoxythece
7-XIII. Podoluma

8 Structure of Wood

USDA For. Serv. Res. Note FPL-04. Slightly revised 1980

Instead of being a relatively solid material like steel or concrete, wood is basically composed of many tubular fiber units, or cells, cemented together. Many properties of wood are related directly to its structure. The detailed illustrations and descriptive text explain the distinguishing cellular characteristics of a hardwood and of a softwood.

9 Current Statistical Methods for Estimating Lumber Properties by Proofloading

Johnson, Richard A.
For. Prod. J. 30(1):14-22. 1980

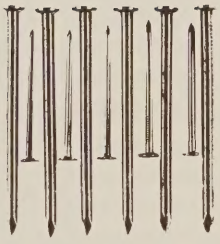
Recently, interest has increased in measuring structural performance through testing of full-size commercial lumber. Proofloading has been proposed as one method of reducing the testing effort for the many grades, sizes, and species of lumber. This paper explores, from a statistical perspective, the nature of current proofloading research to help prepare for further use of this technique in lumber property assessment.

10 **Strength of Wood Beam with End Splits**

Murphy, Joseph F.
USDA For. Serv. Res. Pap. FPL 347. 1979

In grading timber for beams it is useful to have a quantitative measure of the effect of end splits on beam strength. The method presented gives a way of predicting when an end crack will propagate, resulting in a loss of stiffness and strength. This method of solution simplifies the results while investigating the effect of different orthotropic parameters.

Buildings & Construction



11 **Toward Improved Structural Design of Housing Components**

McCutcheon, W. J., R. L. Tuomi, R. W. Wolfe, D. S. Gromala
In Housing: Planning, Financing, Construction. Vol. 2, p. 734-749. 1979
Oktay Ural, ed.; Pergamon Press

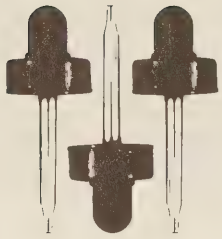
Ongoing research described here aims (1) to understand how light-frame structures (i.e. conventional North American wood-frame houses) actually perform and (2) to develop improved methods for analysis, design, and construction based on the principle of structural continuity (no member acts alone in carrying the imposed loads). Traditional design methods analyze such structures piece by piece, ignoring the intricate structural interactions between floor, wall, and roof. This paper discusses major component design, as well as recent advances in quantifying composite action and structural continuity.

12 **Tapered Double Cantilever Beam Fracture Tests of Phenolic-Wood Adhesive Joints. Part 1. Development of Specimen Geometry; Effects of Bondline Thickness, Wood Anisotrophy, and Cure Time on Fracture Energy**

Ebewele, Robert, Bryan River, and James Koutsky
Wood and Fiber 1(3):197-213. 1979

In developing reliability criteria for rigid adhesive joints, few researchers have attempted to use the double cantilever beam experiment that has been successful in determining durability of metal bonding. Tapered wood beams are bonded with a phenol-resorcinol adhesive and specimens are subsequently fractured. The objectives were to see if the technique could be applied to typical wood gluing procedures and to determine the effects of bondline thickness, wood grain orientation, and cure time on fracture energy.

Chemistry



13 Symposium on Extractives: Utilization Problem or Fine Chemical Resource?

Rowe, John W.
J. Agric. and Food Chem. 28(2):169-170. 1980

Extractives are those plant materials extraneous to the plant cell wall that can be expressed or removed by extraction with inert solvents. In this introduction to a Symposium on Extractives the author outlines the importance of extractives in inhibiting or enhancing utilization of biomass and the increasing role of extractives as an important source of organic chemicals.

14 Outlook for Chemical Wood

Zerbe, John I.
1980 Agricultural Outlook. Prepared for the Committee on Agriculture, Nutrition, and and Forestry, United States Senate. Dec. 23rd, 1979. p. 130-132

In 1978 most chemical products from wood, mainly of lignin derivatives and alcohol, were obtained as by-products from pulping. But rather than relying on wood residue in the future, such industries are likely to use more roundwood as plants are developed for pyrolysis, gasification, hydrogenation, and chemical conversion. Several examples of such plants are given, along with estimates of the amounts of timber they will require in five years.

15 Tall Oil Precursors in Three Western Pines: Ponderosa, Lodgepole, and Limber Pine

Conner, Anthony H., Marilyn A. Diehl, and John W. Rowe
Wood Science 12(3):183-191 1980

Tall oil and sulfate turpentine are important naval stores commodities obtained as byproducts of the kraft (sulfate) pulping of conifer wood chips. But recovery of naval store by-products is considered more difficult from western pines than from southern pines. Results here confirm that the nonsaponifiables content is higher in western pines, causing greater difficulty in distillative refining of tall oil.

16 Factors Influencing Fungal Degradation of Lignin in a Representative Lignocellulosic Thermomechanical Pulp

Yang, H. H., and M. J. Effland, and T. K. Kirk
Biotechnology and Bioengineering 22(1):65-77. 1980

Probably the major technical impediment to developing biological conversion processes for lignocellulosics, is the physical protection lignin exerts against cellulolytic enzymes. One promising way to attack this barrier appears to be with white-rot fungi. This study was to maximize the rate of lignin decomposition in a thermomechanical pulp by the white-rot fungus *Phanerochaete chrysosporium.*

17 **Ligninolytic System of *Phanerochaete chrysosporium:* Inhibition by *o*-Phthalate**

Fenn, Patrick and T. Kent Kirk
Arch Microbiol. 123:307-309. 1979

In studies to optimize lignin degradation by this fungus, the rate of degradation was enhanced twofold over previously described rates by changing buffers from *o*-phthalate to 2,2-dimethylsuccinate. Results indicate that phthalate inhibition should be a useful tool in future studies to define the enzymic steps and the chemical mechanisms of lignin degradation by fungi.

18 **Selectivity of Lignin Removal in a Hydrotropic System: The Influence of Temperature and Acid Catalyst Concentration**

Springer, Edward L. and Lawrence L. Zoch, Jr.
Paperi ja Puu-Papper Och Tra
61(12):815-811. 1979

The effects of reaction temperatures and sulfuric acid concentration on removal of lignin were observed at yields comparable to those of chemical pulping. Although the rates of removal were altered by changes in both variables, it was not possible to enhance the selectivity of lignin removal by changes in these factors.

19 **Fractionation—Purification of an Industrial Kraft Lignin**

Lundquist, Knut and T. Kent Kirk
Tappi 63(1):80-82
1980

The potential of the by-products lignins from kraft pulping operations (kraft lignin) as renewable chemical resources has long been recognized. Unfortunately, kraft lignins have often been studied with little purification. This paper describes the simple purification by fractionation of an industrial kraft lignin and some of the properties of the fractions.

Degradation & Protection

20 **Protecting Woodwork Without Preservatives**

Feist, William C.
USDA For. Serv. FPL Unnumbered Publication. 1979

Small amounts of wax, in the absence of preservative, can provide long-term protection to window units and other wood exposed above ground. This FPL finding can represent a saving of money and resources and avoid preservatives in items such as birdhouses and sheds. The authors include a simple, easily prepared formula for a water repellent treatment.

21 **Principles for Protecting Wood Buildings from Decay**

Scheffer, T. C. and A. F. Verrall
USDA For. Serv. Res. Pap. FPL 190. Revised 1979

This is a minor revision of the popular 1973 research paper dealing with decay in buildings and the means to avoid or control it. Emphasis throughout is on the two primary means of protecting against decay: (1) using drywood and construction methods to keep wood dry, and (2) treating wood with a suitable preservative in areas where dry conditions cannot be maintained.

22 **Smoldering Initiation in Cellulosics Under Prolonged Low-Level Heating**

Schaffer, E. L.
Fire Technology 16(1):22-28, 1980

Some evidence has long indicated that wood products will eventually combust when heated for a long time at temperature even as low as 100°C. Such a response significantly affects the safe use of cellulosic materials and their regulation by code authorities. A model is presented here for predicting this time to smoldering, and thus, what times cellulosics may be safely subjected to low level (90° to 200°C) heating. Results of applying the model compare favorably with known experience.

23 **Mechanisms of Wood Decay and the Unique Features of Heartrots**

Highley, T. L. and T. Kent Kirk
Phytopathology 69(10):1151-1157. 1979

Of the several thousand wood-decaying fungi, only a few hundred cause decay in the hearts of living trees. The authors discuss some unique features of heartrots in light of decay mechanisms and factors affecting wood decay.

24 **Efficacy of Organic Acids in Protection of Tropical American Woods Stored in the Form of Chips**

Eslyn, Wallace E.
Material und Organismen 14(3):185-192. 1979

To control biodeterioration in stored chips, samples from 17 Colombian hardwoods were treated with organic acids. In the decay tests an organic acid mix prevented decay entirely at a concentration of 2 percent. Individually, caproic acid proved more effective than propionic.

25 **Termite Control: Decayed Wood Bait**

Esenther, Glenn R. and Raymond H. Beal
Sociobiology 4(2):215-222. 1979

Discovery that subterranean termites were strongly attracted to wood infested with the brown-rot fungus *Gloeophyllum trabeum* (Pers. ex Fr.) Murr., stimulated development of termiticidal baits for controlling such wood-destroying termites. Experimental work includes trials of treatment effectiveness under field conditions and in residential structures; relation of bait treatment to stages of building contruction; termite foraging behavior; and antitermite agents in baits.

26 **Oxygen Index Evaluation of Fire-Retardant-Treated Wood**

White, Robert H.
Wood Science 12(2):113-121
1979

The oxygen index is the minimum percentage of oxygen that is required to maintain flaming combustion of a specimen under specific laboratory conditions. Study results show the oxygen index test can indicate the flammability of a fire-retardant-treated wood sample relative to other treated and untreated wood products. Data can be used to measure behavior under test method conditions not under fire conditions.

27 **Exocuticular Structures on the Sternal Gland Segments of Rhinotermitidae**

Liang, M. Y., H. C. Coppel, F. Matsumura, and G. Esenther
Sociobiology 4(2):169-190. 1979

Termites often follow trails marked by species-specific substances laid down from termite sternal glands. Because of the importance of these glands in termite foraging behavior, and thereby bait control, a detailed study was made of the exocuticular structures of sternal gland segments of Rhinotermitidae with both the light and the scanning electron microscopes.

General

28 **Forestry Development in Papua New Guinea**

Lindell, Gary R.
J. of For. 78(3):152-155. 1980

Forests cover 80 percent of the land surface of Papua New Guinea and represent a major resource that nation would like to use. But economic, physical, technological, and administrative problems interfere. Now the national government is taking steps toward a new forest policy which may have important implications for regional trade.

29 **Wood Products Used in Constructing Highways in the United States**

McKeever, David B. and William H. Reid
Southern Lumberman, Dec. 15, 1979.
p. 105-106

Summarizes by region the wood products used and use trends in new U. S. highway construction, noting that overall small increases in total lumber and plywood highway use have occurred since 1970. The future for wood products use appears bright, partly because of new technological developments, and partly because wood is less energy intensive than such building materials as steel, aluminum, and concrete.

Processing

30 **A New Look at Aspen Studs**

Maeglin, Robert
The Timber Producer 11:36. 1979

Use of the S-D-R concept (Saw, Dry, and Rip) may allow for normal volume yields from aspen stud production with virtually no rejects due to warp. This paper outlines the process, the hypothesis upon which its success is based, and the results of preliminary studies. Such results from this Forest Products Laboratory process may permit utilizing the surplus aspen in the Lake States and adjacent Canadian provinces.

31 **Application of Ultrasonics in the Wood Industry**

McDonald, Kent A.
Ultrasonics International 1979 Conference Proceedings. Kongress Zentrum Stefaniensaal. Graz, Austria. 1979

In wood, sound travels about three times faster in the longitudinal grain direction than in the radial or tangential directions. In addition, localized areas of distorted or disrupted grain affect the rate of sound movement. This paper outlines experimental results and potential applications of ultrasonics as a computer-control and automatic scanning method that can decrease waste while keeping up with the production rates.

32 **High Temperature Drying of 7/4 Yellow-Poplar Flitches for S-D-R Studs**

Boone, R. Sidney and Robert R. Maeglin
USDA For. Serv. Res. Pap. FPL 365. 1980

As the S-D-R (Saw, Dry, and Rip) concept was being developed at the Forest Products Laboratory, the need was clear for a workable, dependable high-temperature kiln schedule. This study developed high-temperature drying schedules for 7/4 random-width yellow-poplar flitches that would result in the least degrade as determined visually.

Residues & Energy

33 Should Whole-Tree Chips for Fuel be Dried Before Storage

Springer, Edward L.
USDA For. Serv. Res. Note FPL-0241. 1979

Whole-tree chips are presently being used for fuel in several heating and power plants, a use expected to greatly increase in the near future. This suggests the need to store some of them even though the deterioration rate of whole-tree chips in storage is usually significantly greater than that for clean, debarked chips. This Note discusses past findings on pile storage of whole-tree chips, advantages of drying for storage, and relative costs.

34 Wood Processing, Forestry, and Agricultural Wastes

Zerbe, John I.
Presented at Symposium on "New Fuels and Advances in Combustion Technologies" 1979

Forestry wastes are finding increasing use for fuel but are also being converted to energy through direct burning, liquefaction, and gasification. Residue availability and various paths and equipment for residue combustion are discussed as well as production of synthesis gas from wood gasification.

Wood Materials

35 Economic Feasibility of Red Oak Press-Lam for Upholstered Furniture Framestock

Hoover, William L., Carl A. Eckelman, Ronald W. Jokerst, and John A. Youngquist
For. Prod. J. 29(11):21-25
1979

The Press-Lam concept of producing lumber by parallel-laminating thick, rotary-cut veneer promises to increase utilization of low-quality sawtimber while reducing the cost of the furniture frame. This cooperative study evaluated the feasibility of producing and utilizing Press-Lam for upholstered furniture framestock. Feasibility was assessed from the standpoints of engineering performance, presumed marketability, and calculated rate of return to a Press-Lam manufacturer.

36 **Hardwood Press-Lam Crossties: Processing and Performance**

Tschernitz, J. L., E. L. Schaffer, R. C. Moody, R. W. Jokerst, D. S. Gromala, and C. C. Peters
USDA For. Serv. Res. Pap. FPL 313. 1979

The potential to produce railroad ties by a modified Press-Lam system focuses on treatability of the material and the rapid conversion to a high yield of dry structural products. This report discusses the research undertaken, the results obtained, preliminary plant economics, and intrack performance to date.

37 **Press-Lam: New Technology**

Youngquist, J. L., D. S. Gromala, R. W. Jokerst, and J. L. Tschernitz
Concepts, May-June 1979, p. 27-28.
American Wood Preservers Institute

A bridge was recently built in Virginia from pressure-creosoted timbers, manufactured by the Press-Lam method. The design, manufacture, installation, and proof loading of this Press-Lam bridge project are discussed briefly, as is the Press-Lam process itself.

38 **Minimizing Press Time for Radiofrequency-Cured Flakeboard**

Lyon, Duane E., Paul H. Short, and William F. Lehmann
For. Prod. J. 30(2):33-38. 1980

Because minimizing press time is critical to economical flakeboard production, one answer is to incorporate radiofrequency heating in the pressing operation. This study compares hot-pressed panels heated by radiofrequency with steam-heated platen-cured panels made in earlier studies. Minimum press time was determined by sequentially reducing press times within each set of panels until delamination occurred.

Cooperative Research

Listed below are recent publications from universities or individuals involved in cooperative research with the Forest Products Laboratory. Copies are not available from the Laboratory, but may be obtained from the contacts listed following each publication.

Diversified Firms Entering the Wood-based Industry by Merger: A Review

O'Laughlin, Jay, and Paul V. Ellefson
Staff Paper Series No. 7

Contact College of Forestry and the Agriculture, Forestry, and Home Economics, University of Minnesota, St. Paul, Minn. 55455

Fiberboard: Its Role as a Building Material

Johnson, J. A., and H. M. Montrey
AIChE Symposium Series, Vol. 76, No. 195, 1980.

Contact H. M. Montrey, Weyerhaeuser Company, Composite Products Research and Development, Tacoma, WA 98402

Cost of Manufacturing Structural Flakeboard Panel Products

Harpole, G. B.
AIChE Symposium Series, Vol. 76, No. 195, 1980.

Contact American Institute of Chemical Engineers, 345 East 47th Street, New York, NY 10017

A Monthly Model of the United States Demand for Softwood Lumber Imports

Buongiorno, Joseph, Jieh-Jen Chou, and Robert N. Stone
Forest Science, 25(4):641-655. 1979.

Contact Joseph Buongiorno, University of Wisconsin, Department of Forestry, Madison, WI 53706

Economic Structure of the U. S. Timber Industry: Special Focus on Primary Processing

Ellefson, Paul V.
Staff Paper Series No. 11

Contact Department of Forest Resources, College of Forestry and the Agricultural Experiment Station, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota, St. Paul, Minn. 55455

Does Superoxide Ion Oxidize Catechol, α-Tocopherol and Ascorbic Acid by Direct Electron Transfer?

Nanni, Edward J. Jr., Martin D. Stallings, and Donald T. Sawyer
J. of American Chemical Society 102:4481-4485. 1980.

Contact Prof. Donald T. Sawyer, Department of Chemistry, University of California, Riverside, CA 92521

Interpretation of Curing Mechanism of Furfuryl Alcohol Resins

Milkovic, Jovan, George E. Myers, and Raymond A. Young
Cellulose Chemistry and Technology 13:651-672. 1979.

Contact Raymond A. Youngs, Department of Forestry, University of Wisconsin, Madison, WI 53706

Evaluation of New Shear Property Test Methods for Thick Particleboard.

Hunt, M., J. McNatt, D. Fergus
Forest Products Journal 30(2):39-42. 1980.

Contact Michael O. Hunt, Department of Forestry and Natural Resources, Purdue University, West LaFayette, Ind. 47907

Thermal Degradation of Kraft Lignin in Tetralin

Connors, W. J., L. N. Johanson, K. V. Sarkanen and P. Winslow
Holzforschung 34(1):29-37. 1980.

Contact Department of Chemical Engineering, University of Washington, Seattle, WA 98195

Forest Soil Biology—Timber Harvesting Relationships

Jurgensen, M. F., M. J. Larsen, and A. E. Harvey
USDA For. Serv. Gen. Tech. Rept. INT-69.

Contact Intermountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, 507 - 25th Street, Ogden, UT 84401

Fire - Decay: Interactive Roles Regulating Wood Accumulation and Soil Development in the Northern Rocky Mountains

Harvey, A. E., M. J. Larsen, and M. F. Jurgensen
USDA For. Serv. Res. Note INT-263.

Contact Intermountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, 507 - 25th Street, Ogden, UT 84401

Probing Amplitude, Phase and Polarization of Microwave Field Distributions in Real-Time

King, R. J., and Y. H. Yen
Presented at 1980 North American Radio Science Meeting, Quebec, Canada, June 2-6, 1980.

Contact University of Wisconsin, Dept. of Electrical and Computer Engineering, Madison, WI 53706

A Study of Lumber Used for Bracing Trenches in the United States

Knab, Lawrence I., Felix Y. Yokel, William L. Galligan, B. Alan Bendtsen, and John F. Senft
National Bureau of Standards Building Series 122, 1980.

Contact National Bureau of Standards, Center for Building Technology, National Engineering Laboratory, Washington, D.C. 20234

How to Buy Construction Lumber

Oviatt, Alfred E.
University of Wisconsin Ext. Pub., A3035. 1979.

Contact Agricultural Bulletin Building, 1535 Observatory Drive, University of Wisconsin, Madison, WI 53706

Ordering Publications—Change of Address

Single copies of publications listed in "Dividends From Wood Research" are available free of charge. Fill out the order blank on the back cover by circling the identification number of the publication desired, detach card, stamp, and mail. If you have moved, return the order blank and indicate your new address. Whether ordering publications or changing your address, DO NOT REMOVE THE LABEL SHOWING YOUR NAME AND ADDRESS. The label is used for publication mailings and to update our mailing lists.

U.S. GOVERNMENT PRINTING OFFICE: 1980-750-027/19

Please

Add_____
Continue_____
Discontinue my name on list _____

Please Print New Address If Changed

Name _____

Company _____

Address _____

City _____

State, Zip Code _____

PLACE
POSTAGE
HERE
(FIRST CLASS)

INFORMATION
U. S. FOREST PRODUCTS LABORATORY
P. O. BOX 5130
MADISON, WISCONSIN 53705
U.S.A.

Bulk Rate
Postage & Fees Paid
USDA-FS
Permit No. G-40

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
FOREST PRODUCTS LABORATORY
P. O. BOX 5130
MADISON, WISCONSIN 53705

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

ADDRESS CORRECTION REQUESTED

1 2 3 4 5 6
7VIII 7IX 7X 7XI
7XII 7XIII 8 9
10 11 12 13 14 15
16 17 18 19 20 21
22 23 24 25 26 27
28 29 30 31 32 33
34 35 36 37 38

Please refer to the identification number on your mailing label when corresponding about the mailing list of publications

1980/2

DO NOT REMOVE LABEL

RETURN THIS PORTION ONLY